Interview Summary	Application N . 09/809043	Applicant(s) AOI
	Examiner TOLEDO	Art Unit 2823

All participants (applicant, applicant's representative, PTO personnel):

(1) Jerry Massie
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(3) Masaoki Kajiyama
(4) Yasuhito Kumabuchi
(5) George Fourson
(6) Fernando Toledo

Date of Interview: Sept. 24, 2003

Type: a)☐ Telephonic b)☐ Video Conference
c)☒ Personal [copy given to: 1)☐ applicant 2)☒ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: all in general

Identification of prior art discussed: all relied on in general

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

* Applicant will amend to place claims indicated as allowable in independent form. Applicant proposes to amend claims ~~to require~~ which would change the scope and require ~~new~~ ~~issues~~ further search and/or ~~new~~ consideration. Proposed amendment attached.

George Fourson
PRIMARY EXAMINER

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

Proposed claims on September 22

IN THE CLAIMS:

1. (Withdrawn)

2. (Withdrawn)

3. (Withdrawn)

4. (Withdrawn)

5. (Cancelled)

G Attachment to Int. Summary 7/24/03

6. (Currently Amended) The method for forming a semiconductor device of Claim 18, wherein the first cross-linking molecules are first organic molecules having three or more sets of functional groups in one molecule,

the second cross-linking molecules are second organic molecules having two sets of functional groups in one molecule, and

the three-dimensionally polymerized organic polymer is formed by ~~10~~ binding the three or more sets of functional groups of each of the first organic molecules and the two sets of functional groups of each of the second organic molecules together.

7. (Currently Amended) The method for forming a semiconductor device film of Claim 6, wherein the first organic molecules are represented by

$$\begin{array}{c} X_2 \\ | \\ X_1 \text{---}\ R_1 \ \text{---} X_1 \\ | \\ X_2 \end{array}$$

(where R_1 is a first organic skeleton, X_1 is a first set of functional groups, and X_2 is a second set of functional groups, X_1 and X_2 being same or different in type),

the second organic molecules are represented by

$$Y_1 - R_2 - Y_2$$

(where R_2 is a second organic skeleton, Y_1 is a third set of functional groups, and Y_2 is a fourth set of functional groups, Y_1 and Y_2 being same or different. in type),

the three-dimensionally polymerized organic polymer is formed by binding the first set of functional groups (X_1) and the third set of functional groups (Y_1) together and binding the second set of functional groups (X_2) and the fourth set of functional groups (Y_2) together, and

the molecular level pores are formed in regions surrounded by the first organic skeletons (R_1) and the second organic skeletons (R_2).

8. (Currently Amended) The method for forming a semiconductor device of Claim 6, wherein the first organic molecules are represented by

$$\begin{array}{ccc} & X_1 & \\ & | & \\ Z\text{---} & R_1 & \text{---}X_2 \\ & | & \\ & X_1 & \end{array}$$

(where R_1 is a first organic skeleton, X_1 is a first set of functional groups, X_2 is a second set of functional groups, and Z is a third set of functional groups, X_1 and X_2 being same or different in type),

the second organic molecules are represented by

$$Y_1 - R_2 - Y_2$$

(where R_2 is a second organic skeleton, Y_1 is a fourth set of functional groups, and Y_2 is a fifth set of functional groups, Y_1 and Y_2 being same or different in type),

the three-dimensionally polymerized organic polymer is formed by first binding the first set of functional groups (X_1) and the fourth set of functional groups (Y_1) together and binding the second set of functional groups (X_2) and the fifth set of functional groups (Y_2) together to form a plurality of units and then binding the third set of functional groups (Z) of the plurality of units together, and

the molecular level pores are formed in regions surrounded by the first organic skeletons (R_1) and the second organic skeletons (R_2) in the plurality of units.

9. (Currently Amended) The method for forming a semiconductor device of Claim 18, further comprising the steps of:

forming a surface barrier film on the interlayer dielectric film;

forming a mask on the surface barrier film;

forming a concave portion in the surface barrier film and the interlayer dielectric film by etching the surface barrier film and the interlayer dielectric film using the mask; and

forming an interconnection made of a metal material by filling the concave portion with the metal material.

10. (Currently Amended) The method for forming a semiconductor device of Claim 9, wherein the first cross-linking molecules are first organic molecules having three or more sets of functional groups in one molecule,

the second cross-linking molecules are second organic molecules having two sets of functional groups in one molecule, and

the three-dimensionally polymerized organic polymer is formed by binding the three or more sets of functional groups of each of the first organic molecules and the two sets of functional groups of each the second organic molecules together.

11. (Canceled)

12. (Canceled)

13. (Amended) The method for forming a semiconductor device of Claim 18, further comprising the steps of:

forming a mask on the interlayer dielectric film;

forming a concave portion in the interlayer dielectric film by etching the interlayer dielectric film using the mask;

forming a sidewall barrier film on sidewalls of the concave portion; and

forming an interconnection made of a metal material by filling the concave portion having the sidewall barrier film with the metal material.

14. (Canceled)

15. (Canceled)

16. (Canceled)

17. (Canceled)

18. (Currently Amended) A method for forming a semiconductor device, comprising the steps of:

polymerizing first cross-linking molecules having a three-dimension<u>al</u> structure and second cross-linking molecules having a two-dimensional structure to form an interlayer dielectric film composing a three-dimensionally polymerized <u>organic</u> polymer having a number of molecular level pores.

Specifically,

the first cross linking molecules have

1 three dimensional structure,

2 functional group as a bond to other molecules (a second molecules),

3 bonded to the functional group of second cross linking molecules.

Likewise,

the second cross linking molecules have

1 two dimensional structure,

2 functional group as a bond to other molecules (a first molecules),

3 bonded to the functional group of first cross linking molecules.

three dimensional unit composed of the first and second cross linking molecules

And an ILD (interlayer dielectric) is composed of plurality of these units, and this ILD has

1 three dimensional structure,

2 polymerized organic polymer,

3 molecular level pores.

<<three dimensional network structure(referring to page 24) >>

19. (New) The method for forming a semiconductor device of Claim 18, wherein the three-dimensionally polymerized organic polymer has a unit with diamond structure.

20. (New) The method for forming a semiconductor device of Claim 19, wherein the unit with diamond structure is composed of three hexagons sharing two sides with one another.

21. (New) The method for forming a semiconductor device of Claim 18, wherein the three-dimensionally polymerized organic polymer has a basket-like unit.

22. (Amended) The method for forming a semiconductor device of Claim 21, wherein the basket-like unit is composed of <u>two</u> hexagons sharing two <u>apexes</u> with one another.

23. (New) The method for forming a semiconductor device of Claim 7, wherein the first organic molecules are adamantine derivatives, and the second organic molecules are benzene derivatives.

24. (Amended) The method for forming a semiconductor device of Claim 8, wherein the first organic molecules are benzene derivatives<u>, and the second organic molecules are phenanthrene derivatives</u>.

Attention: Claims 20, 22, 23 and 24 are rewritten in independent form including all of the limitations of the base claim and any intervening claims.

In the claims:

25. (New) A method for forming a semiconductor device, comprising the steps of:

polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure to form an interlayer dielectric film composing a three-dimensionally polymerized organic polymer having a number of molecular level pores;

wherein the three-dimensionally polymerized organic polymer has a unit with diamond structure which is composed of three polygons having the first cross-linking molecules in six apexes and sharing three apexes with one another.

26. (New) A method for forming a semiconductor device, comprising the steps of:

polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure to form an interlayer dielectric film composing a three-dimensionally polymerized organic polymer having a number of molecular level pores;

wherein the three-dimensionally polymerized organic polymer has a basket-like unit which is composed of two polygons having the first cross-linking molecules in six apexes and sharing two apexes with one another.

Summary : A method for forming a semiconductor device

◆The purpose of this invention

An interlayer dielectric film includes non-continuous pores having a size of molecular level dispersed uniformly by forming a porous organic polymer film without cutting cross-linked sites of an organic polymer.

◆The feature of this invention

An interlayer dielectric film made of a three-dimensionally polymerized organic polymer is formed by polymerizing: first cross-linking molecules having three or more sets of functional groups in one molecule providing a three-dimensional structure; and second cross-linking molecules having two sets of functional groups in one molecule providing a two-dimensional structure.

◆The effect of this invention

The above construction ensures the formation of the three-dimensionally polymerized polymer having a number of molecular level pores inside. Hence the interlayer dielectric film is good in mechanical strength, heat resistance and adhesion to a substrate.

Comparison of each inventions

◆Brown et al. (USP.No.5,962,113)

Brown discloses that a dielectric material of an interlayer dielectric film composes of a reaction product of an organic polysilica (SiO2) and a polyamic ester preferably terminated with an alkoxysilyl (Si-OH) alkyl group.

In other words, the above interlayer dielectric film composes of an organic and inorganic hybrid film including silicon.

◆This invention

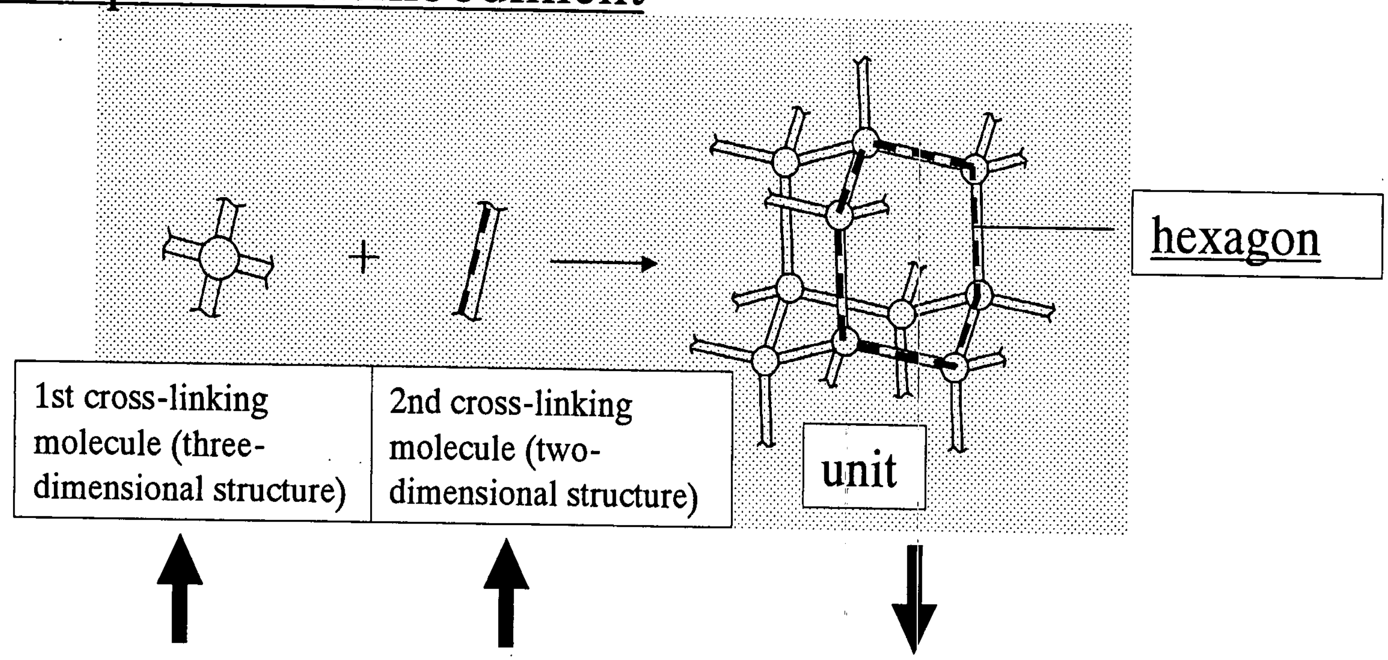
An interlayer dielectric film composes of a three-dimensionally polymerized organic polymer including no silicon.

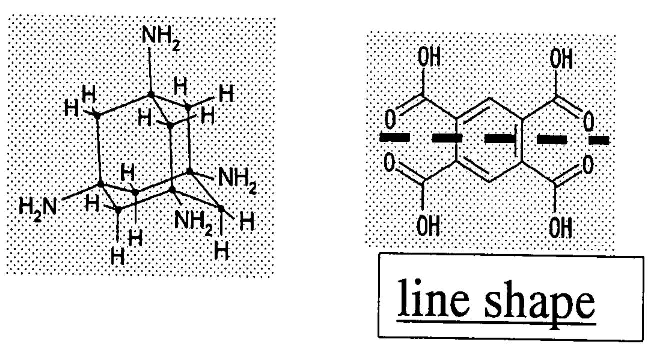
◆Remark to the final rejection

Accordingly, Brown doesn't disclose a three-dimensionally polymerized organic polymer including no silicon.

The feature of this invention (1)

Example of 1st embodiment





◆A unit with diamond structure

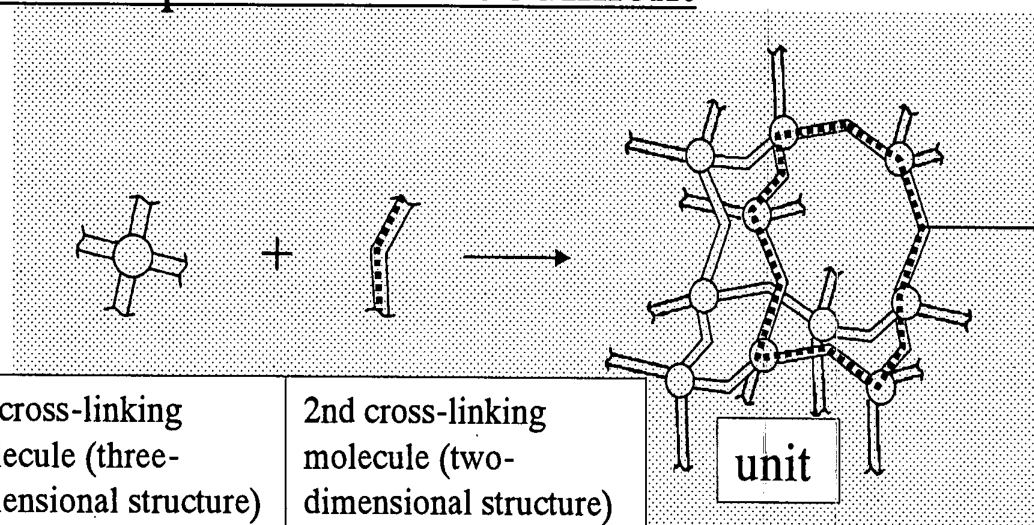
The unit is composed of three hexagons sharing two sides with one another.

The feature of this invention (2)

#09/809,043
(5)

Other example of 1st embodiment

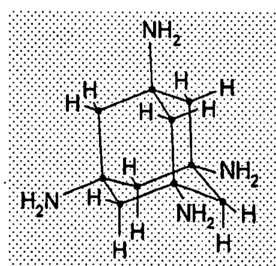
claim 5

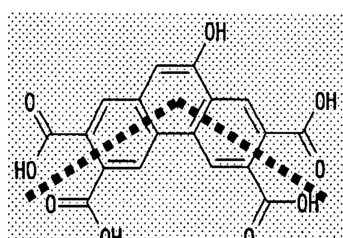


1st cross-linking molecule (three-dimensional structure)	2nd cross-linking molecule (two-dimensional structure)

unit

polygon





bending shape

◆A unit with diamond structure
The unit is composed of three polygons having the first cross-linking molecules in six apexes and sharing three apexes with one another.

In the claims: <2nd scheme>

◆claims 25. (New) A method for forming a semiconductor device, comprising the steps of:

polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure to form an interlayer dielectric film composing a three-dimensionally polymerized organic polymer having a number of molecular level pores;

wherein the three-dimensionally polymerized organic polymer has a unit with diamond structure which is composed of three polygons having the first cross-linking molecules in six apexes and sharing three apexes with one another.

◆claims 26. (New) A method for forming a semiconductor device, comprising the steps of:

polymerizing first cross-linking molecules having a three-dimensional structure and second cross-linking molecules having a two-dimensional structure to form an interlayer dielectric film composing a three-dimensionally polymerized organic polymer having a number of molecular level pores;

wherein the three-dimensionally polymerized organic polymer has a basket-like unit which is composed of two polygons having the first cross-linking molecules in six apexes and sharing two apexes with one another.

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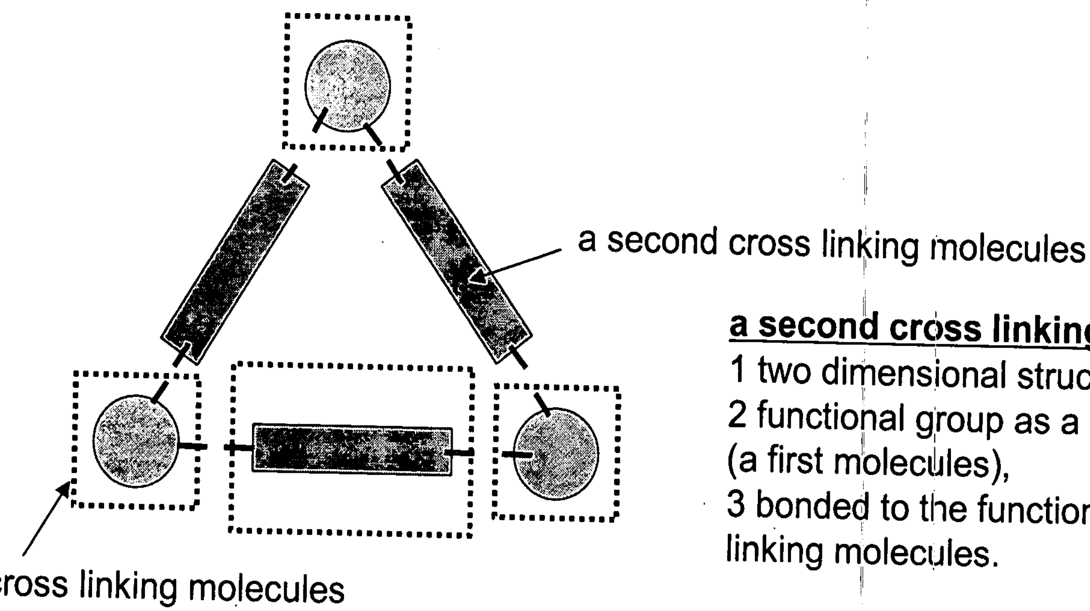

a first cross linking molecules have
1 three dimensional structure,
2 functional group as a bond to other molecules (a second molecules),
3 bonded to the functional group of second cross linking molecules.

a second cross linking molecules have
1 two dimensional structure,
2 functional group as a bond to other molecules (a first molecules),
3 bonded to the functional group of first cross linking molecules.